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Graphene, analogue gravity and holography

Wednesday, 1 September 2021 17:00 (30 minutes)

The study of the physics of graphene-like materials opens up new connections between condensed matter and high energy physics. Graphene and other 2D materials realize the physics of spinorial fields, whose Dirac properties emerge due to the structure of the lattice with which the charge carriers interact. The peculiar sheet characteristics determine a natural description of its electronic properties in terms of massless pseudoparticles, giving the possibility to observe quasirelativistic particle behaviour at sub-light speed regime.
It is therefore possibile to argue that the geometric curvature of a two-dimensional sample, combined with the aforementioned special relativistic-like behaviour, naturally leads to a general relativistic-like description for our pseudoparticles, behaving as Dirac quantum fields in a laboratory 1+2 dimensional curved background.
We will see how the emergence of intrinsic and extrinsic curvature in graphene-like materials can be used to investigate Dirac quantum dynamics in curved spacetime, as well as to probe certain quantum gravity scenarios. This formulation follows a *bottom-up* approach, where a condensed matter system (the 2D lattice) provides analogs of gravitational effects, so that the propagation of quantum fields is dictated by an effective metric, taking then advantage of mathematical tools from Einstein gravity. In particular, some optical responses of a graphene sample can be obtained, for suitable geometries, in peculiar ranges of energy and give rise to new experimental effects and observations.
Finally, we will propose new theoretical results that conjecture the use of graphene and other 2D materials to have alternative (unconventional) realizations of some special symmetries, exploiting an holographic *top-down* approach. In the latter formulation, the substrate description originates from a well-defined geometric definition of a suitable, higher-dimensional gravity model.

Is this abstract from experiment?

No

Name of experiment and experimental site

N/A

Is the speaker for that presentation defined?

Yes

Details

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Internet talk

Yes

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